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SCOPING REPORT

ACADIA NATIONAL PARK  
WATER RESOURCES MANAGEMENT PLAN

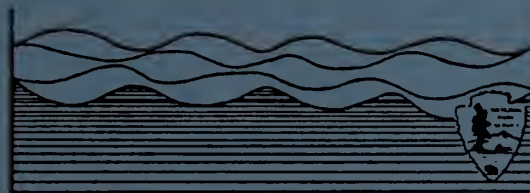
Prepared by  
National Park Service

in cooperation with  
Acadia National Park

Technical Report NPS/NRWRD/NRTR-91/04

WATER RESOURCES MANAGEMENT  
PLAN  
ACADIA NATIONAL PARK  
NATIONAL PARK SERVICE  
DEPARTMENT OF THE INTERIOR

WATER RESOURCES DIVISION



National Park Service • Department of Interior  
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ACADIA NATIONAL PARK  
WATER RESOURCES MANAGEMENT PLAN

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Technical Report NPS/NRWRD/NRTR-91/04

September 1991

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## INTRODUCTION

An area on Mount Desert Island was set aside and established as "Sieur de Monts National Monument" in 1916. In 1919, the United States Congress declared these lands a national park and changed the name to "Lafayette National Park" (16 U.S.C. 341). The boundaries were enlarged and name changed to "Acadia National Park" in 1929 (16 U.S.C. 342a and 342b).

The park consists of approximately 35,000 acres located along coastal Maine in Hancock and Knox counties. The principal holdings include approximately 30,000 acres on Mount Desert Island, 3,000 acres on Isle au Haut, and 2,000 acres on the Schoodic Peninsula. In addition, the National Park Service manages several other small isolated areas on the surrounding islands.

Acadia National Park preserves "for the benefit and enjoyment of the people" significant portions of the "downeast" northern Maine coast and offshore islands. Management goals strive to preserve the scenic, natural, and historical resources while offering visitors an increased awareness of their natural and cultural heritage. The management of the water resources relates to these goals, whether it is by providing clean water for water-based recreation, serving as a focal point for a significant scenic view, or functioning in ways that preserve important dimensions of a cultural or historic scene.

The landforms in Acadia National Park consist of a series of separate north-south oriented ridges separated by deep U-shaped valleys, with elevations ranging from sea level to 1530 feet. These landforms are a result of glacial and marine erosion acting upon the pink granite of Mount Desert Island (Butcher, 1977). As the glaciers disappeared from the land, the basins they formed by widening and deepening valleys formed the major freshwater ponds in the park. One valley, connected to the sea, formed Somes Sound, the only true fjord on the Atlantic coast of the United States.

Freshwater drainage systems in Acadia National Park originate in the central uplands and consist of small streams and brooks, interlaced with many lakes, ponds, marshes, and bogs. Watersheds are typically small, developing short drainage systems, which generally empty into the sea within a few miles of their origin. As a result, streams remain small, but lakes, ponds, and wetlands are extensive and comprise a substantial portion of Acadia's natural ecosystems.

There are approximately thirty lakes and ponds on Mount Desert Island (2 acres - 897 acres) and one pond on Isle au Haut (73 acres) which are significant enough to be named on topographic maps (1:62,500). In addition to being important scenic and recreational resources, these coastal lakes provide important habitat for native species, serve as public water supplies, and are used as important spawning areas and seasonal habitat for anadromous species including alewives, smelt, salmon, and eels. (National Park Service, 1988).

Similarly, large areas of wetlands consisting of salt and freshwater marshes, sphagnum-sedge and scrub bogs, alder scrub, and black spruce-tamarack swamps contribute to the water-related natural resources of the park. Bass Harbor Marsh and Northeast Creek are two wetland areas on Mount Desert Island that are affected by tidal action and function as estuarine ecosystems. Great Meadow, Fresh Meadow, and Bliss Field are major freshwater marshes on Mount Desert Island that provide

valuable waterfowl habitat. Acadia National Park also contains numerous bogs and heaths. Sunken Heath in Bar Harbor and Big Heath in Southwest Harbor, are two of the major bogs found on Mount Desert Island.

## *WATER RESOURCES MANAGEMENT PLAN*

Whether in support of natural systems or providing for visitor use, water is often a significant resource in units of the National Park System. Consistent with its fundamental purpose, the National Park Service (NPS) seeks to perpetuate surface and ground waters as integral components of park aquatic and terrestrial ecosystems, by carefully managing the consumptive use of water and striving to maintain the high quality of surface and ground waters in accordance with all applicable federal, state, and local laws and regulations. In addition, the NPS assures compliance with all floodplain management and wetland protection requirements and obtains and uses water for the preservation, management, development, and use of the National Park System in accordance with legal authority and with due consideration of the needs of other water users.

An essential step in addressing a park's water resources issues is planning. In parks where water resources are sufficiently important, complex, or controversial, a Water Resources Management Plan is often prepared. The Water Resources Management Plan structures and uses information about the park's hydrologic resources to assist management in evaluating the range of alternatives concerning water resources issues.

There are three major sections in a Water Resources Management Plan. First, the plan provides the necessary background with respect to the park and water resources issues, concerns, and needs which have led to the preparation of a Water Resources Management Plan. In particular, this section provides information on laws, regulations, and policies applicable to the park, and land status and uses adjacent to the park. This section also sets forth the objectives concerning use and management of water in the park and lists the specific water resources issues that have been identified for evaluation in the plan. The second major section of the plan provides sufficient information to characterize the hydrologic setting of the park and to describe the current condition and status of park water resources. Depending on the hydrologic resources of the park and the water resource issues to be addressed, the description of the hydrologic environment section should summarize published information, and perform, where necessary, an analysis of available unpublished data, including information relating to the physiography, climate, and geology; surface water resources; groundwater resources; aquatic and riparian resources and habitats; water uses within the park; and water rights. The final section of the plan presents the action program of the planning effort. This section includes specific project statements which describe day-to-day operational activities and special projects necessary to address the water resources issues facing the park. These activities and projects may consist of management, monitoring, interpretation, law enforcement specifically directed toward water resources protection, program administration, research, management studies, and mitigation/treatment action. Guidance for the development of a Water Resources Management Plan may be found in "Instructions for the Preparation of Water Resources Management Plans" (National Park Service, 1989).

## AVAILABILITY OF WATER RESOURCES PLANNING INFORMATION

One objective of the "scoping" process is to identify existing natural resources information and studies that provide background information regarding potential water resources issues and concerns. Acadia National Park's Resources Management Plan (National Park Service, 1988) provides a solid general overview of natural resources information and studies pertaining to Acadia National Park.

Acadia National Park has been the site of numerous water resources-related investigations dating from the 1920s. While the objectives and study designs of these investigations have varied considerably, many provide important background information and insight regarding various water-resources issues. But while background information and baseline data for Acadia National Park's aquatic resources is extensive for some areas, it is almost non-existent for others. Following is a list of sources of water resources-related information relevant to the development of a Water Resources Management Plan.

### 1- Basin Physiography, Geology, and Climate

The physiography of Acadia National Park has been influenced by continental movements, igneous activity, glaciation, periods of deposition and erosion of sedimentary rock, and marine erosion. Butcher (1977) and Gilman et al. (1988) present a concise overview of the physiographic and geologic processes that interact to develop the landforms that are present today in Acadia National Park. Acadia National Park's climate is influenced largely by its latitude and marine influences. Because of the marine influence, coastal areas of Maine have cooler summers, warmer winters, a narrower range of temperature extremes, and a longer frost-free season than inland areas of Maine. Mean annual precipitation, however, is greater, with coastal precipitation averaging from 3 to 7 inches more on the coast than at inland Maine locations. The National Park Service has maintained a weather station in Acadia National Park since 1940. Data from this station has been summarized by the National Climatic Center (1972), Patterson et al. (1983), and the National Park Service (1988). These data (1940 - present) are available from the National Weather Service (Station No. 0371).

In addition to routine weather data, Acadia National Park has been included in a number of special studies documenting the occurrence and effects of acidic atmospheric deposition. The mean weighted pH of precipitation is about 4.4, with wet sulfate ( $\text{SO}_4$ ) deposition of 15-20 kg/ha/yr (Kahl et al., 1985a; 1985b). This deposition of both hydrogen ion and sulfate is in excess of the amount thought to have negative impacts on sensitive water resources in other regions receiving acidic atmospheric deposition. Studies focusing upon the impacts of acidic atmospheric deposition on aquatic systems in the general vicinity of Acadia National Park include Andersen (1984), Davis et al. (1978), Kahl and Norton (1983), Kahl et al. (1985a; 1985b), Norton et al. (1981), Norton (1987), and Norton and Kahl (1987).

Weekly precipitation chemistry (1980-present) is available for Acadia National Park from the National Atmospheric Deposition Program. Further studies documenting the chemical composition of fog have been conducted by Kimball et al. (1988) and

Jagels et al. (1989). A further study by Weathers et al. (1988) collected both cloudwater and rainwater chemistry (1984-1985) at Bar Harbor, ME. This study found that the Bar Harbor cloudwater samples had the highest median concentrations of hydrogen ion (i.e. lowest median pH), nitrate, and sulfate of any of the ten sites monitored across the United States.

Soils within Acadia National Park are thin, and predominantly of glacial origin. In areas where climax coniferous forests have developed, thicker deposits of organic materials may occur (National Park Service, 1988). Approximately 35 soil associations occur within Acadia National Park. Soil association maps for the park have been prepared as part of the Maine Coastal Inventory (State of Maine, 1977) and updated maps are presently being reviewed and will soon be published by the Soil Conservation Service. Additionally, more detailed soil series maps are available for some areas of the park located near towns (Southwest Harbor, Isle au Haut, Somesville, and Winter Harbor).

## 2- Surface Water Resources and Water Quality

Of the 30 freshwater lakes and ponds on Mount Desert Island with areas greater than 2 acres, all but six are at least bordered by Acadia National Park. Long Pond on Isle au Haut is bordered by Acadia National Park and is the only freshwater pond on that island.

Lakes and ponds of over ten acres in surface area are designated as "great ponds" by the State of Maine. The Maine Department of Inland Fisheries and Wildlife has jurisdiction over all "great ponds" within the state. These include Long Pond, Eagle Lake, Seal Cove Pond, Echo Lake, Jordan Pond, Somes Pond, Lower Hadlock Pond, Little Long Pond, Round Pond, Hogdon Pond, Upper Hadlock Pond, Aunt Betty Pond, Bubble Pond, Witch Hole Pond, Lake Wood and Hamilton Pond on Mount Desert Island, and Long Pond on Isle au Haut. Other significant ponds on Mount Desert Island, ranging from 2 to 10 acres in size, include Upper Breakneck Pond, The Tarn, Lower Breakneck Pond, Duck Pond, The Bowl, French Hill Pond, Seawall Pond, Bear Brook Pond, Half Moon Pond, Ripple Pond, Sargent Mountain Pond, and Fawn Pond.

Most of the lakes and ponds in Acadia National Park are classified as low elevation oligotrophic waters with low buffering capacities (Davis et al., 1978). Their biological productivity is generally low, but may be increasing in watersheds such as Long Pond and Echo Lake, where nutrient levels from shoreline development can influence nutrient loading (Olday, 1975). The low specific conductance, limited buffering capacity, and clear waters of the ponds and lakes of Acadia National Park are generally indicative of waters that may be sensitive to the effects of acidic precipitation (Kahl et al., 1985b).

Limited water quality information is available for Acadia's freshwater systems prior to 1980. Early profiles of water temperature, pH, dissolved oxygen and phosphorus concentrations are provided for Long Pond, Eagle Lake, Seal Cove Pond, Echo Lake,

Jordan Pond, Somes Pond, Long Pond, Upper Hadlock Pond, and Bubble Pond by Fuller and Cooper (1946). Olday (1975) presents limnological data (dissolved oxygen, alkalinity, pH, nutrients, algae, bacteria, and benthic macroinvertebrates) for Echo Lake and Long Pond. Norton et al. (1981) provide pH and cation data for a number of the park's lakes and ponds. Some additional data on "great ponds" water quality may also be available from the Maine Department of Environmental Protection (Welch et al., 1981).

A detailed study of the water quality and sediment chemistry of Acadia's freshwater resources was undertaken from 1982 - 1984 by Kahl et al. (1985a, 1985b). During this study, the water chemistry of 18 lakes and 23 first- and second-order streams were monitored to ascertain present water quality and possible impacts from acidic atmospheric deposition. Constituents monitored included water temperature, pH, alkalinity, specific conductance, color, sulfate, calcium, magnesium, potassium, sodium, iron, zinc, silica, aluminum, and manganese.

A current study by Kahl and his associates is collecting weekly and event-related water quality samples in the Upper Hadlock Pond watershed to further investigate the episodic nature and impacts of acidic precipitation events. This study (NARO Cooperative Agreement CA1600-5-0005, Amendment 11) is scheduled for completion in September, 1990.

The water quality of Somes Sound has been the subject of two published investigations. Folger et al. (1972) conducted a comprehensive study that: 1) explored the temperature, salinity, dissolved oxygen, and suspended sediment content of the water; 2) determined the sediment characteristics at 83 different locations; and 3) measured the biological oxygen demand at several selected locations. Ketchum and Cass (1986) conducted spring and fall water column monitoring in Somes Sound in 1986. The objectives of this study were: 1) to determine the spring stream flow and nutrient transport into Somes Sound; 2) to measure the spring temperature and salinity structure in order to estimate flushing rate during spring conditions; and 3) to make a preliminary survey of the nutrient distribution of the sound.

A site specific water quality study was initiated in Marshall Brook in 1979 as the result of adjacent land use activities. Marshall Brook, which empties into the Atlantic Ocean at Bass Harbor, had been subject to pollution by leachate from an adjacent landfill. Once considered one of the best trout streams in the area, Marshall Brook had declined as a fishery, reportedly because of impaired water quality resulting from the adjacent landfill. Hansen (1980b) reports decreased dissolved oxygen and elevated levels of un-ionized ammonia and other dissolved constituents. Subsequent studies by Soukup and Mitchell (1981), and Soukup et al. (1984) confirm these results and found that specific conductance, nitrate and nitrite, total Kjeldahl nitrogen, chloride, potassium, and sodium were elevated in the main ditch draining the landfill and in affected downstream areas of Marshall Brook. The level of contamination was found to be severe enough to harm fisheries resources as well as other components of the native aquatic community. Follow-up studies by Gerber (1980, 1982, 1985a, and 1985b) and Sewall (1982) have led to the closure of this landfill operation. However,

a recent survey (Gerber, 1989) indicates that while there is continuing water quality improvement in Marshall Brook, concentrations of several constituents remain significantly elevated from background levels in ditches draining the closed landfill.

Significant portions of many of the watersheds in Acadia National Park lie outside of the Park's boundary and are dependent upon state and local regulations to protect habitat and water quality. There are a number of former landfill sites which could be impacting water resources and all of the towns maintain uncovered road salt storage areas. The number, type, and condition of existing underground storage tanks is also unknown.

The development of a Water Resources Management Plan will require the completion of a point source/non-point source inventory and, possibly, the linkage with the existing GIS-compatible data base for these land uses, within and outside Park boundaries, so that the Park will be better able to undertake pro-active resource protection through increased cooperation with state regulators, town planning boards, etc.

### 3- Groundwater Resources and Water Quality

Hansen (1980a) assesses the availability of groundwater from the various geologic units in Acadia National Park. Yields from 160 wells in crystalline bedrock range from 0.5 to 100 gallons per minute with a median yield of 10 gallons per minute. Yields from individual wells located in unconsolidated surficial deposits are generally low (0 - 10 gallons per minute), though a few wells have moderate yields (50 - 100 gallons per minute). Groundwater resource maps for all of Hancock County are also available in Caswell (1975a, 1975b) and Caswell and Lancot (1975).

In addition to groundwater wells, a number of underground springs are also present on Mount Desert Island. To date, no studies have been conducted that would provide quantitative information regarding these water sources.

Most of the groundwater in Acadia National Park and vicinity is reported to be of good quality and is satisfactory for domestic use (Hansen, 1980a). However, some wells do yield iron and manganese concentrations that exceed U.S. Environmental Protection Agency criteria for domestic use. There is also a concern that local groundwater wells could be contaminated from overloaded or improperly functioning septic tanks or cesspool leachate, particularly during the heavily used summer months, and especially in areas undergoing rapid development.

Further, elevated concentrations of Radon-222, ranging from 692 to 34,866 pCi/L (pico curies per liter) have been reported from 15 wells underlying Mount Desert Island (Hess et al., 1979). These levels do present a potential localized public health concern.

There is also a suggestion that the Worcester gravel pit may be leaching pollutants into the groundwater, contaminating waters moving towards Long Pond, a public water supply for the Town of Southwest Harbor (Gerber, 1982). Several monitoring wells are maintained to further investigate this possible problem (Gerber, 1989).

#### 4- Fisheries and Aquatic Biological Resources

In a 1920s fisheries survey, Batchelder (1927) found that the streams and ponds of Mount Desert Island sustained 13 species of fish. A 1940s study by Fuller and Cooper (1946) provides further water quality information and fisheries data for Long Pond, Eagle Lake, Seal Cove Pond, Echo Lake, Jordan Pond, Somes Pond, Long Pond, Upper Hadlock Pond, and Bubble Pond. Today, the Maine Department of Inland Fisheries and Wildlife manages several of the "great ponds" for a variety of sport-fish species including the lake trout (Salvelinus maycush), native brook trout (Salvelinus fontinalis), landlocked salmon (Salmo salar), and brown trout (Salmo trutta). Stocking records for these species are available from the Maine Department of Inland Fisheries and Wildlife.

Anadromous species such as alewives, smelt, and eel, which utilize the freshwater system for spawning and seasonal habitat are also abundant. Little quantitative information regarding these species is available for Acadia National Park.

So far, no adverse effects of acidic atmospheric deposition on fisheries populations has been reported for this region. However, a comprehensive baseline fisheries inventory and information regarding biocontaminants in the fish is generally lacking and form a present data need.

Little is known about the amphibian populations living in Acadia National Park or their sensitivity to acidification. Davis (1959) and Hunter et al. (in preparation) provide information on species reported for the park, but studies on the potential impacts of acidification on breeding and larval mortality have not been completed locally.

A survey of Long Pond (Isle au Haut) was completed in the 1920s by Bishop and Clark (1922). More recent information on Long Pond may exist, but has not been located.

#### 5- Wetlands

Wetlands for much of coastal Maine have been mapped as part of the U.S. Fish and Wildlife Service's National Wetlands Inventory (NWI) at either the 1:24,000 or 1:62,500 scale (State of Maine, 1987a; 1987b). In Acadia National Park the NWI mapping was completed at the 1:62,500 (15 minute quadrangle) scale. Wetlands maps at a the 1:50,000 scale were completed for the region by the Maine Geological Survey (Mullen and Tolman, 1984). In both cases, generally only wetlands greater than 10 acres in size, have been mapped on Mount Desert Island. The accuracy and

detail often are not sufficient for planning purposes. The various towns on Mount Desert Island are currently working on more detailed wetlands maps.

## 6- Paleolimnology

Paleolimnology attempts to reconstruct various aspects of a watershed's history from the record left in sediment cores of bogs and lakes. Several paleolimnological studies have been conducted at Acadia National Park in which lake and bog sediments were core-sampled in order to reconstruct approximate vegetation, fire, and atmospheric deposition patterns over the last several hundred years.

Davis (1967) sampled Eagle Lake in order to reconstruct the history of vegetative patterns back to pre-settlement times. Further work determining the long-term vegetative history of Mount Desert Island is currently being conducted by Patterson and his colleagues at the University of Massachusetts from cores taken from the Bowl and Lake Wood.

Kahl et al. (1985b) have sampled sediments from Sargent Mountain Pond, The Bowl, and Long Pond (Isle au Haut) in order to assess patterns of atmospheric pollutants. The sediment record in these waters indicate that measurable air pollution has occurred as early as the mid- to late 1800s in the form of increased lead, zinc, and copper concentrations. Thus, Kahl et al. (1985b) concluded that long-term acidification may have been occurring slowly in these waters. Norton and Kahl (1987) and Norton (1987) compared atmospheric pollutants found in sediment cores taken from lakes with those taken from Big Heath, an ombrotrophic peat bog. The results supported the hypothesis that Acadia National Park has been subjected to increasing fossil fuel-related atmospheric pollutants since the mid-1800s.

## 7- Geographic Information System (GIS)

Earlier planning projects in Acadia National Park have resulted in GIS databases being developed for various themes including elevation, land use, vegetation, surface water, boundaries and development. These files have been converted into Arc Info and are presently available at the College of the Atlantic located in Bar Harbor. Acadia National Park is presently cooperating with the College of the Atlantic and is in the process of establishing an Arc Info-based GIS system within the park.

In addition, Binford et al. (1989) has established a specific GIS data base defining the limits of the drainage basins for 15 lakes in Acadia National Park. This information is presently being used for watershed development/water quality modeling activities being conducted by the Graduate School of Design at Harvard University.

An evaluation of the existing GIS data bases and their applicability to the development of the Water Resources Management Plan is presently being assessed by the Water Resources Division and Acadia National Park.

## **WATER RESOURCES MANAGEMENT PLANNING ISSUES AT ACADIA NATIONAL PARK**

Water Resources Division, North Atlantic Regional Office, and Acadia National Park personnel held an initial scoping session at Acadia National Park on July 11-12, 1989. The purpose of this scoping session was to identify water resources issues and concerns of park management. Subsequent discussions have been held with additional National Park Service personnel, state officials, water resource researchers, and interested citizens in order to further define potential issues and concerns.

Specific water resources issues identified for consideration in the Water Resources Management Plan include:

### **1) Impacts of Atmospheric Deposition on Sensitive Lakes and Ponds**

The majority of the lakes and ponds of Acadia National Park are poorly buffered, oligotrophic, and potentially sensitive to acidification. While on-going monitoring efforts and research studies have demonstrated that Acadia National Park is subjected to severe air pollution, including acidic atmospheric deposition (median pH = 4.4), a 1982 - 1984 study by Kahl et al. (1985a; 1985b) showed that except for Sargent Mountain Pond and, periodically, some small headwater brooks, the waters of Acadia National Park generally display pH values greater than 6. However, the chemical status of Sargent Mountain Pond and the small brooks indicate that chronic acidification or loss of alkalinity are possibilities at some sites. The 1982 - 1984 water quality data for the 18 lakes and 23 first- and second-order streams from the Kahl study provides an excellent baseline against which future sampling can be compared and trends established.

The Water Resources Management Plan should develop alternatives for a periodic inventory and monitoring program for a continued periodic assessment of the impacts of atmospheric deposition on sensitive lakes and ponds. Kahl et al. (1985b) suggest follow-up surveys at 5-10 year intervals, dependent upon deposition trends during the preceding period. The rationale for such a program should be developed and various cost alternatives, including participation in cooperative (interagency) programs need to be explored. Needs for additional research and monitoring activities, such as episodic monitoring, the determination of bioaccumulated contaminants (e.g. heavy metals) in invertebrates or fish, or the continuation or periodic re-establishment of a calibrated watershed study should also be assessed.

### **2) Water Quality Impacts of Development and "Overboard" Discharges**

Several significant water resource features of Acadia National Park including Long Pond, Echo Lake, Seal Cove Pond, Bass Harbor Marsh, and Somes Sound are currently experiencing development pressures along their shorelines. Development is primarily residential, including summer cottages, with minor commercial development adjacent to Bass Harbor Marsh. In addition, a new large marina has also been proposed for Bass Harbor.

When forested land is converted to residential use both the volume and quality of surface runoff may change. Impervious structures such as buildings, driveways, and roads are constructed over previously pervious soil. Small scale irregularities of the forest are flattened for lawns and gardens, thus reducing natural storage retention areas. Natural drainage ways may be altered with storm runoff concentrated

in ditches. These changes can significantly increase the amount of water leaving the site as surface runoff, sometimes by as much as 50%. Also, the runoff is often found to contain higher concentrations of phosphorus.

Another development-related concern is that inadequate septic systems and/or "overboard" discharges could also increase nutrient loading, potentially affecting the quality of these waters. Research has shown that wastewater may contribute significantly to the nutrient load carried by groundwater into surrounding surface waters (Persky, 1986; Yates, 1985). A recent study by Valiela and Costa (1986) links increased nutrient enrichment in a coastal embayment on Cape Cod with intensive shoreline development and the subsoil injections of nutrients into groundwater from septic tanks. In addition, septic systems may also represent a significant source of pathogens, including both bacteria and viruses, which if not properly designed and constructed, may constitute a public health issue.

While the development pressures on Mount Desert Island are presently much less intensive than those occurring on Cape Cod, the National Park Service is currently initiating a study in order to investigate the impacts of "overboard" discharges on the estuarine environments of Bass Harbor Marsh. The Water Resources Management Plan should provide a discussion of growth and development patterns on Mount Desert Island. Local and county building ordinances should be investigated to assure that adequate non-point source pollution control is required. An inventory of municipal sewer systems, septic tanks, and overboard discharges for Mount Desert Island should be completed and added to the park's database. Results of the Bass Harbor Marsh "overboard" discharge study should also be utilized to provide the park and local municipalities with an assessment of the problem and to recommend management strategies, research needs, and monitoring requirements, interagency cooperation, etc. necessary to mitigate existing or potential problems.

The Maine Department of Environmental Protection has expressed an interest in non-point source pollution affects on Maine's lakes and has provided a number of excellent suggestions for reducing nutrient input from runoff (State of Maine, 1987c).

### 3) Jurisdictional & Management Issues Relating to "Great Ponds"

Seventeen natural ponds or lakes in Acadia National Park larger than 10 acres are classified as "great ponds" and were placed under the jurisdiction of the state by the "Great Ponds Ordinance of Massachusetts Bay" in 1641 - 1647. Under this ordinance these "great ponds" are owned by the state for the benefit of the general public, who are granted "fishing" and "fowling" rights to any "great pond" and guaranteed a right of access to such bodies.

In accordance with this ordinance, the "great ponds" in Acadia National Park are open to the public with certain restrictions. They receive a variety of recreational uses, some of which may be inconsistent with National Park Service policies and management goals. Non-native fish species have been introduced for recreational fishing, and hunting and trapping occur on water surfaces well within, and completely surrounded by the park. Off-Road-Vehicle (ORV) use is allowed on the "great ponds" in the winter, though otherwise excluded from the park.

It is a goal of the National Park Service to manage natural resources in a manner that will preserve and maintain ecosystems and allow those natural processes to function without human-induced interference. The Water Resources Management Plan should address the jurisdictional and management issues relating to the "great ponds" within Acadia National Park. Policy issues such as

fish stocking and species management, access, recreational usage, and water rights need to be investigated. Alternatives need to be evaluated which would actively promote the increased cooperation between the State of Maine and the National Park Service in attaining mutually beneficial management objectives.

#### **4) Monitoring and Management of Fisheries Resources**

While fisheries surveys were conducted in some of Mount Desert Island's largest lakes and ponds in the 1920s (Batchelder, 1927), the 1940s (Fuller and Cooper, 1946), and the 1950s (Havey, 1958), Acadia National Park lacks a comprehensive baseline of its fisheries resources. The need for such a baseline inventory is critical to proper natural resource management, especially considering the potential significant impacts to fisheries from lake acidification and fish stocking activities. Acadia National Park's Revised Resource Management Plan (National Park Service, 1990) describes the need for developing a fisheries resource inventory. Components of such an inventory should include: 1) completion of a baseline inventory of both freshwater and anadromous fish populations; 2) compilation and analysis of historical fish stocking records; 3) implementation of an analysis of bioaccumulation of contaminants (e.g. heavy metals) by fish; 4) analysis of historical impacts to fisheries and development of mitigation strategies; and 5) development of a strategy for long-term monitoring of the fisheries resources.

The Water Resources Management Plan should summarize the available fisheries, bioaccumulated contaminants, and fish stocking information and provide objectives and study design for the recommended fisheries inventory and monitoring program.

#### **5) Management and Protection of Wetlands and Riparian Zones**

Wetland communities in Acadia National Park exhibit an array of important functions and values including providing waterfowl and wildlife habitat, serving as nurseries for estuarine and marine species, contributing to groundwater aquifer recharge, and influencing flood and erosion control. Wetlands are also an important recreation resource providing opportunities for canoeing, fishing, wildlife observation, and outdoor education.

Federal law and National Park Service guidelines mandate the proper protection and management of wetlands. The Water Resources Management Plan needs to assess present wetlands mapping and inventory information in order to provide management with recommendations regarding information needs necessary to meet protection and management requirements. In addition, the Water Resources Management Plan should identify actual or potential wetlands impacts and/or cross-boundary wetlands issues.

Presently, the State of Maine holds jurisdiction over tidal waters. Boundary delineation between "tidal waters" and "wetlands" are obscure. A course of action should be defined leading to proper boundary resolution and jurisdictional delineation.

Further, the Water Resources Management Plan should provide management with a discussion of other wetland issues, alternatives, and recommendations necessary to fully comply with National Park Service wetlands protection and management mandates.

In addition, riparian zones adjacent to water resources provide important habitat for a number of species including beavers and otters. Guidance for the protection of these areas within the Park and alternatives including increased environmental education/cooperation with private land owners outside the park should be explored to better protect this important habitat.

#### **6) Radon-222 in Potable Water Supplies**

In recent years there has been a growing concern regarding Radon-222, a radioactive gas that occurs in nature. Hess et al. (1977) report that radon gas is often associated with uranium decay from granitic bedrock in areas such as Mount Desert Island. This is a concern in Acadia National Park since radon gas can enter homes through individual groundwater wells and be released into park housing. In the past, radon levels have been routinely monitored in four different park housing location. The results of these monitoring activities should be discussed, and appropriate monitoring and/or mitigation alternatives recommended.

#### **7) Giardia and "Backcountry" Drinking Water**

Giardia is generally believed to be present on Mount Desert Island and has been diagnosed as occurring in local dog populations. Monzingo (1985), Kunkle et al. (1985), and Monzingo and Stevens (1986) found that in Rocky Mountain National Park the numbers of Giardia present in mountain streams was often related to beaver activity.

Many urban visitors to Acadia National Park assume that Acadia National Park's waters are pristine and hikers have been observed routinely drinking out of the streams. The Water Resources Management Plan should address this issue and recommend to management the needs for proper visitor notification, environmental education, or research necessary to document this potential public health issue.

#### **8) Water Resources Issues Related to Existing and Proposed Park Operations and Development**

If not properly planned and managed, park operations and internal development activities can adversely affect the water resources within a National Park Service unit. Such activities may include: 1) construction of new park facilities or expansion of existing facilities, 2) road maintenance activities, 3) wastewater management, and 4) hazardous materials storage and the management of underground storage tanks.

The initial scoping session held at Acadia National Park did not reveal any park operational or internal development activity deleteriously impacting the park's water resources. However, the Water Resources Management Plan should discuss these issues and provide an inventory of wastewater management practices, underground storage tanks locations and hazardous materials handling procedures utilized in Acadia National Park.

## 9) Issues Considered but not Deemed Appropriate for the Water Resources Management Plan

Several additional issues were identified at the scoping session, but not deemed necessary for development in the Water Resources Management Plan. These include:

a) Marshall Brook Contamination - As noted previously, Marshall Brook was severely impacted in past years from a landfill that operated adjacent to the park boundary from the 1930s through the early 1980s. Due to the environmental impacts from the runoff of its leachate, the landfill was closed in the mid-1980s. Annual follow-up studies, sponsored by the Town of Southwest Harbor, indicate improving water quality conditions in Marshall Brook. While concentrations of several constituents remain elevated in ditches draining the former landfill site, there is very low flow and considerable ponding. It is felt that Bass Harbor marsh is no longer being threatened by leachate emanating from the closed landfill site. The National Park Service strongly supports the continuation of follow-up monitoring by the township, but does not believe further action is warranted at the present time. The Water Resources Management Plan should merely acknowledge the past issue and briefly summarize the research, mitigation, and monitoring efforts undertaken to correct the problem.

b) Floodplain Issues - National Park Service policy discourages development in the floodplain, and the only park facilities known to exist in the floodplain of Acadia National Park are internal park roads or recreational facilities which are functionally dependent on their proximity to water. Hurricanes are rare in coastal Maine and the threat to life and property in Acadia National Park from flooding is thought to be low. While the park should develop and coordinate necessary emergency evacuation plans with local law enforcement agencies, the State of Maine, and the National Weather Service, this task is beyond the scope of the Water Resources Management Plan.

c) Water Rights Issues - Water rights issues at Acadia National Park could involve riparian water rights, absolute ownership ground water rights, rights associated with responsibilities at "great ponds", and Federal reservation purposes. Consumptive water use on Mount Desert Island is from small yield wells with the exception of a few of the larger towns which take water for municipal purposes from some of the larger ponds. There could be localized impacts to other wells or surface water-related resources such as wetlands or riparian areas due to withdrawal of groundwater or diversion of surface water. Surface water diversions could also impact anadromous fisheries habitat in streams that headwater in the park, then cross private lands downstream before flowing into the Atlantic Ocean. However, no water quantity problems have been identified as a result of this water use pattern and no changes are expected over the next five to ten years, therefore, the potential for interference due to groundwater withdrawals or municipal use is low and no WRMP water rights issues have been identified.

A recent solicitor opinion indicates that under certain circumstances the NPS has ownership interest and/or regulatory jurisdiction over some surface water ponds. The opinion considers 1) the Colonial Ordinance of 1641, as amended in 1647,

provision concerning "great ponds", 2) the Property and Supremacy Clauses of the United States Constitution, and 3) Acadia National Park's enabling legislation. As a prerequisite to resource management, further guidance from the Solicitor should be sought specifically addressing the water rights implications of these legal statutes. Although no specific water quantity issues have been identified, the water rights aspect of the "great ponds" ordinance should be assessed in the WRMP as part of Planning Issue No. 3, Jurisdictional and Management Issues Relating to "Great Ponds".

## *RECOMMENDATIONS*

It is the recommendation of the Water Resources Division that a Water Resources Management Plan be developed for Acadia National Park. Water-related resources comprise a significant component of the natural resources of the park. While existing information related to water resources is extensive for some areas, it is virtually non-existent for others. In addition, there are a number of relatively complex water resources issues facing the park which warrant the development of an integrated management strategy. Predominant issues include the potential impacts from shoreline development and adjacent land use, potential impacts from the continued influence of acidic atmospheric deposition, complex jurisdictional and management issues relating to "great ponds" and an almost complete lack of resource information relating to the park's aquatic biological resources. The development of a Water Resources Management Plan would provide Acadia National Park with a blueprint for the management of water resources over the next 5-10 years.

Because of staff constraints both within the park and the Water Resources Division, it is recommended that the Water Resources Management Plan be developed under either a cooperative agreement or competitive contract. Because of the amount of research already completed, and the initiation of an estuarine study which should provide important information regarding the potential impacts of "overboard" discharges, it is estimated that a Water Resources Management Plan could be completed over a two year time period at an approximate cost of \$ 27,000 per year. The Resource Management staff at Acadia National Park and the North Atlantic Regional Office's Water Resources Coordinator would jointly manage this project. The Water Resources Division will provide the park and cooperator with technical support and review. The Water Resources Division would also be available to assist in the analysis of policy issues, especially those aspects relating to water rights.

## LITERATURE CITED

- Andersen, Janet Lee. 1984. Potential impact of acid precipitation and poor air quality on the resources of Acadia National Park. National Park Service, North Atlantic Regional Office OSS 85-1. 100 pp.
- Batchelder, C.H. 1927. Inland fishes of the eastern part of Mount Desert Island, Maine. *Ecology* 8:327-332.
- Binford, M.W., K. Hill, and F. Ignatowski. 1989. Long-term human activities and ecosystem responses: progress report to the Aga Khan Foundation. Harvard School of Design, Cambridge, MA.
- Bishop, Sherman C. and Noah T. Clarke. 1922. A scientific survey of Turner's Lake, Isle au Haut, Maine. New York State Museum, Albany, New York. 29 pp.
- Borns, H.W., Jr. 1974. Surficial geology of the Mount Desert Quadrangle. Open File No. 74-7, Maine Geological Survey Map.
- Butcher, R.D. 1977. Field Guide to Acadia National Park, Maine. Readers Digest Press.
- Caswell, W. B., Jr. 1975a. Total depth of bedrock wells in Hancock County. Maine Department of Conservation, Physical Resource Series. Map.
- Caswell, W. B., Jr. 1975b. Yield of bedrock wells in Hancock County. Maine Department of Conservation, Physical Resource Series. Map.
- Caswell, W. B., Jr., and E. M. Lanctot. 1975. Ground water resource maps of southern Hancock County. Maine Department of Conservation, Maine Geological Survey. Maps.
- Chapman, C.A. 1970. The Geology of Acadia National Park. The Chatam Press, Old Greenwich, CT. 128 pp.
- Davis, S.L. 1959. Notes on amphibians in Acadia National Park, Maine. M.S.Thesis. Cornell University, Ithaca, New York.
- Davis, R. B. 1967. Pollen studies of near-surface sediments in Maine lakes. IN Quaternary Paleoecology. E.J. Cushing and H.E. Wright, Jr. (eds.) Yale University Press, New Haven, CT. pp. 143-173.
- Davis, R., M. Smith, J. Bailey, and S. Norton. 1978. Acidification of Maine (USA) lakes by acidic precipitation. *Verh. Int. Verein. Limnology*. 29:532-537.
- Folger, D.W., R.H. Meade, B.F. Jones, and R.L. Cory. 1972. Sediments and waters of Somes Sound, a fjord-like estuary in Maine. *Limnology and Oceanography* 17:394-402.

- Fuller, S.L. and G.P. Cooper. 1946. A biological survey of the lakes and ponds of Mount Desert Island, and the Union and Lower Penobscot River drainage systems. Fish Survey Report No. 7. Maine Department of Inland Fish and Game, Augusta, ME.
- Gerber, R. G. 1980. Landfill impact study: Southwest Harbor, Maine. Gerber, Inc. Freeport, ME.
- Gerber, R. G. 1982. Southwest Harbor Landfill water quality impact study. Robert G. Gerber, Inc. Freeport, ME. 8 pp.
- Gerber, R. G. 1985a. Report to the Southwest Harbor Town Manager on the Worcester Landfill studies. Gerber, Inc. Freeport, ME.
- Gerber, R. G. 1985b. Report to the Southwest Harbor Town Manager on the Worcester Landfill studies, Gerber, Inc. Freeport, ME.
- Gerber, R.G. 1989. Southwest Harbor Annual Water Quality Sampling. Robert G. Gerber, Inc., Freeport, ME. 7 pp.
- Gilman, R.A., C.A. Chapman, T.V. Lowell, and H.W. Borns, Jr. 1988. The geology of Mount Desert Island - a visitor's guide to the geology of Acadia National Park. Maine Geological Survey, Department of Conservation, Augusta, ME. 50 pp. + maps.
- Hansen, B. P. 1980a. Groundwater availability in Acadia National Park and vicinity, Hancock and Knox Counties, Maine. U.S. Geological Survey Open File Report 80-1050.
- Hansen, B. P. 1980b. Reconnaissance of the effect of landfill leachate on the water quality of Marshall Brook, Southwest Harbor, Hancock County, Maine. U.S. Geological Survey Open File Report, 80-1120.
- Havey, K. A. 1958. An investigation of the freshwater fisheries of Mount Desert Island. Maine Department of Inland Fisheries and Wildlife.
- Hess, C.T., S.A. Norton, W. F. Brutsaert, R.E. Casparius, E.G. Coombs, and A.L. Hess. 1979. Radon-222 in potable water supplies in Maine: the geology, hydrology, physics, and health effects. University of Maine. Land and Water Resource Center. Orono, Maine. 119 pp.
- Hunter, M.L., J. Albright, and J. Arbuckles. In Preparation. Amphibians and Reptiles of Maine.
- Jacobson, B. and H. Dominie. 1988. Evaluation of island resources, Hancock County and portion of Knox County, Maine. Report to the National Park Service. North Atlantic Region, Boston, ME.
- Jagels, R., J. Carlisle, R. Cunningham, S. Serreze, and P. Tsai. 1989. Impact of acid fog and ozone on coastal Red Spruce. *Water, Air, and Soil Pollution* 48:193-208.

- Kahl, J.S., J.L. Andersen, and S.A. Norton. 1985a. An evaluation of the Technical Report for Management: Water resource baseline data and assessment of impacts from acidic precipitation, Acadia National Park, ME. National Park Service Document NARO Technical Report 16. 14 pp.
- Kahl, J.S., J.L. Andersen, and S.A. Norton. 1985b. Water resource baseline data and assessment of impacts from acidic precipitation, Acadia National Park, ME. Technical Report #16, National Park Service, North Atlantic Region Water Resources Program. 123 pp.
- Kahl, J.S. and S.A. Norton. 1983. Impact and mobilization of metals in acid stressed lake watersheds. Land and Water Resources Center, University of Maine at Orono, Orono, ME.
- Ketchum, C.B. and D. Cass. 1986. Somes Sound Spring 1986 study, Part I. Prepared for the Somes Sound Association and Town of Mount Desert. 106 pp.
- Kimball, K., R. Jagels, G. Gordan, K. Weathers, and J. Carlisle. Differences between New England coastal fog and mountain fog water chemistry. Water, Air, and Soil Pollution 39:383-393.
- Kunkle, S., N. Cowdin, J. Wilson, J. Grondin, T. Ricketts, and M. Flora. 1985. Field survey of Giardia in streams and wildlife of the Glacier Gorge and Loch Vale basins, Rocky Mountain National Park. Natural Resources Report Series 85-3. U. S. Department of the Interior, National Park Service, Water Resources Division. Fort Collins, CO.
- Monzingo, D.L. 1985. The prevalence of Giardia in a beaver colony and the resulting environmental contamination. Ph.D. dissertation, Department of Pathology, Colorado State University. Fort Collins, CO.
- Monzingo, D.L. and D.R. Stevens. 1986. Giardia contamination of surface waters: a survey of three selected backcountry streams in Rocky Mountain National Park. Water Resources Report 86-2. Water Resources Division, National Park Service. Fort Collins, CO. 17 pp.
- Moore, B. and N. Taylor. 1927. Vegetation of Mount Desert Island, Maine and its environment. Brooklyn Botanic Garden Memoirs 3. 151 pp.
- Mullen, M.K. and A. L. Tolman. 1984. Freshwater Wetlands Maps (Number 7, 20, 21, and 22). Department of Conservation, Maine Geological Survey, Open File 85.
- National Climatic Center. 1972. Climate of Bar Harbor, Maine. Climatography of the United States No. 20. National Oceanographic and Atmospheric Administration, Environmental Data Service. Asheville, NC.
- National Park Service. 1988. Resources Management Plan Update: Acadia National Park. Acadia National Park, Bar Harbor, ME.
- National Park Service. 1989. Instructions for the preparation of Water Resources Management Plans (Draft). Water Resources Division, National Park Service, Fort Collins, CO. 26 pp.

- National Park Service. 1990. Revised Resources Management Plan: Acadia National Park (Draft). Acadia National Park, Bar Harbor, ME.
- Norton, S.A., R.B. Davis, and D.F. Brakke. 1981. Responses of northern New England lakes to atmospheric impacts of acids and heavy metals. University of Maine, Land and Water Resources Center. Orono, ME. 90 pp.
- Norton, S.A. 1987. The stratigraphic record of atmospheric loading of metals at the ombrotrophic Big Heath Bog, Mt. Desert Island, Maine, USA. Effects of Atmospheric Pollutants on Forests, Wetlands, and Agricultural Ecosystems. T. C. Hutchinson and K.M. Meema (ed.) NATO ASI Series Vol. G 16.
- Norton, S.A. and J.S. Kahl. 1987. A comparison of lake sediments and ombrotrophic peat deposits as long-term monitors of atmospheric pollution. IN New Approaches to Monitoring Aquatic Ecosystems, ASTM STP 940, T. Boyle (ed.), American Society for Testing and Materials, Philadelphia, PA. pp. 40-57.
- Olday, F.C. 1975. Mount Desert Island Lake Study. College of the Atlantic, Bar Harbor, ME. 41 pp. + app.
- Patterson, W.A., K. E. Saunders, and L.J. Horton. 1983. Fire regimes of the coastal Maine forests of Acadia National Park. North Atlantic Region Office of Science Studies Report OSS-83-3, National Park Service, Boston, MA.
- Persky, J. H. 1986. The relation of ground-water quality to housing density, Cape Cod, Massachusetts. USGS Water Resources Investigations Report 86-4093. 28 pp.
- Sewall, J. W. Company. 1982. Worcester Associates, Inc.: Report on the Southwest Harbor Sanitary Landfill: drainage, leachate control, and volumetric capacity. Sewall Company. Old Town, Maine.
- State of Maine. 1977. Maine Coastal Inventory Handbook. Land Use Information Series IV. State Planning Office, Augusta, ME. 33 pp.
- State of Maine. 1979. Classification of Surface Waters: Maine Revised Statutes Annotated, Title 38, Chapter 3. Department of Environmental Protection. Augusta, ME. 58 pp.
- State of Maine. 1987a. Index to the National Wetlands Inventory Maps of Maine: 15 Minute Quadrangles. Maine Geological Survey, Department of Conservation, Augusta, ME. 1 p.
- State of Maine. 1987b. Index to the National Wetlands Inventory Maps of Maine: 7.5 Minute Quadrangles. Maine Geological Survey, Department of Conservation, Augusta, ME. 1 p.
- State of Maine. 1987c. The Greening of Maine's Lakes. Maine EnvironNews Vol. 14:1. Maine Department of Environmental Protection. Augusta, ME 4 pp.

- Soukup, M.A. and N. J. Mitchell. 1981. Preliminary report on the evaluation of the water quality of Marshall Brook, Acadia National Park. National Park Service, North Atlantic Regional Office, Water Resource Program Report Number 6. Boston, MA.
- Soukup, M.A., N. J. Mitchell, and R. A. Johnson. 1984. Second seasonal evaluation of the water quality of Marshall Brook, Acadia National Park. National Park Service, North Atlantic Regional Office, Water Resource Program Report Number 8. Boston, MA.
- Valiela, I. and J. Costa. 1986. Eutrophication of Buttermilk Bay, a Cape Cod coastal embayment: concentrations of nutrients and watershed nutrient budgets. *Environmental Management* 12:539-553.
- Weathers, K.C., G.E. Likens, F.H. Bormann, S.H. Bicknell, B.T. Bormann, B.C. Daube, Jr., J.S. Eaton, J.N. Galloway, W.C. Keene, K. D. Kimball, W. H. McDowell, T. G. Siccama, D. Smiley, and R. A. Tarrant. 1988. Cloudwater chemistry from ten sites in North America. *Environ. Sci. Technol.* 22:9 1018-1026.
- Welch, B., M.E. Dennis, and J. Potvin. 1981. 1981 Project Report: The voluntary water quality monitoring program. Maine Department of Environmental Protection, Division of Lakes and Biological Studies, Augusta, ME.
- Yates, M.V. 1985. Septic tank density and groundwater contamination. *Groundwater* 23:586-591.





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As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural and cultural resources. This includes fostering wise use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interest of all our people. The department also promotes the goals of the Take Pride in America campaign by encouraging stewardship and citizen responsibility for the public lands and promoting citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for the people who live in island territories under U.S. administration.

